

# Important Aspects of Using Geographical Information System

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*Abstract:* - This first part of the paper presents a short introduction in GIS technology and its application domains. The second part includes a classification of the GIS products, future research possibilities and a short presentation of equipments for data acquisition. Part three contains a list of the most attractive GIS projects undertaken in the world and in Romania.

*Key-words:* - GIS, Areas to apply, Satellites.

## 1 Introduction

GIS is an abbreviation for Geographical Information System and it is a computer based technology used for mapping and analyzing entities from the Earth's surface. Mainly, GIS is a system used to design information, processes and structures which reflect the real world, including past events. This way we can understand, analyze and administrate resources [4].

Let us assume that we are interested in going on vacation somewhere in the world. However, we want to make sure that we will have a vacation without any unpleasant surprises like bad weather, natural disasters or we simply do not wish to go somewhere where the risk of pollution is very high. We might say that we are very pretentious persons, but I do not really believe that there is any travelling agency (at least not in Romania) that can inform us about these aspects we are interested in. However, we can use a GIS system to inform us about the climate of the place of our choice, about the natural disasters that have taken place in the world or we could simply use it to get a map of the most polluted areas in the last 100 years. By overlapping this information, we can get a certain idea about the place where we will spend our vacation. Maybe this is not such an inspired example and it is certainly not the reason why the GIS system has been created, but we hope we have at least made you a little bit curious and anxious to learn more about this subject.

## 2 Definitions of a GIS

A scientifically definition would be: a computer capable to join, keep, use and display specific geographical information, for example information

about a certain location. A GIS can be described as a data base management system that usually presents information in an interactive graphical manner, which can be neither interrogated nor analyzed. However, do not imagine that GIS is a hardware only system. It is a system made out of calculus equipment, programs, people, methods and norms that allow the processing of data and exploration of maps. We said earlier that GIS can be described as a DBMS. The reason for this is simple: in order to be able to work with such a system, we need an adequate data base, obtained by acquiring data. Although GIS programs can also have data bases organized in proprietary formats, most GIS programs use the classical formats (from FoxPro to ORACLE, MS SQL, DB2, Access or even Excel [5]).

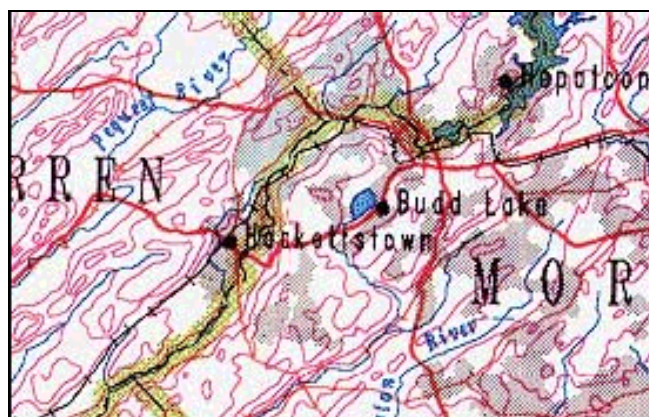


Fig. 1: An example of a GIS map.

The modern GIS have unlimited access through connectivity standards such as: ODBC, COM, CORBA, SQL [6], [7]. An essential component of GIS is its ability to produce graphical data on screen and

paper, producing the results of the analysis made by the people who allocate the resources. The printed papers, as well as other graphical data can be visualized, allowing us to understand the result of analysis and simulations of potential events.

Now that you have understood what we are talking about, let us move on and see.

## 2.1 Input the Data into System

If the data we are about to use are not in a digital format, there are several techniques to help us transform these data [12]. The maps can be digitized or drawn on the computer so we can collect the coordinates of different elements (Fig. 2). Scanning equipment can also convert dots and lines from a map into digital format. Introducing data into our system is the most time consuming component when we are talking about GIS. Every appearance of objects in a map must be specified; the special relationships between objects must also be specified. Editing the gathered information can also be a difficult task [9]. Electronic scanners record stains on a map with the same accuracy they capture the interesting objects on the same map. For example, a stain can connect two lines that they should not ordinarily meet. Such unwanted data must be edited or erased from our files.



Fig. 2: Examples of digitized maps.

*Where does all data come from?* All gathered data, piled into a GIS data base, come from different sources: satellite data, existing data bases, classical archives, etc. The role of a GIS system is to put together all these data in one single system.

## 2.2 Sources to Gather Information and Using Information Gathered

Certain data available in an electronically format that can be used by a GIS come from Federal Agencies and private companies. Different information found in the form of a map can be integrated into a GIS system. Moreover, a GIS can convert existing digital information, other than maps, in formats known to the system and then use them. For example, the digital imagines from satellites can be analyzed for the purpose of producing a layer of digital information concerning vegetation areas. Furthermore, hydrological or demographical information found in tables can be converted into maps. They are then used as important layers in a GIS. The geographical information in a GIS must be recorded so that they match information in other maps. Before digital data is analyzed, they must undergo other modifications, like projection conversion. This allows data to be introduced into our system. Projection is an essential component when creating a map. It represents the mathematical interpretation of translation from three-dimensional curbs to two-dimensional ones-screen, paper. Different projections are used for different maps, because each projection is suited for a specific map. For example, a projection that precisely represents the shape of the continents will distort their relative dimensions. While most part of the information found in a GIS comes from pre-existing maps, computer power is used to integrate digital information that comes from different sources. Because digital data is gathered and stock in different ways, two sources cannot be one hundred percent compatible. Therefore, a GIS must be able to convert data from a structure to another. Satellite data that have been read with the help of a computer in order to produce a map can be "read" by a GIS in a raster format. Raster files have rows of uniformly coded cells depending on the values of the data. Raster files can be easily manipulated by a computer, but they usually have fewer details than vector files, which can better approximate traditional maps. Digital vector data have been captured as points, lines or surfaces.

A GIS can combine different types of maps and show realistically three-dimensional images, that present information efficiently and to a broader audience than traditional, two-dimensional maps. Classical maps do not represent the real world. They are a sum of important elements put on a piece of paper in the shape of symbols representing physical objects. People who use these maps must interpret these symbols. Topographical maps reveal the shape of the land using level curbs. The real shape of the land can only be seen in our minds. The presentation techniques of the GIS make it possible for us to see the relationships between the elements of the map, thus making it easier for us to extract and analyze the information. It is difficult to make a connection between a map representing muddy areas and the registered quantity of precipitations in a certain point.

GIS can be used to draw bi-dimensional and three-dimensional characteristics of the Earth, the depth and the atmosphere of different points of information. For example, GIS can easily generate a map (with lines) representing the quantity of precipitations. Such a map can be thought of as a precipitation map. A lot of sophisticated methods can estimate the characteristics of certain surfaces, using only a limited number of measurements. In a GIS a bi-dimensional level curbs map created from precipitation measurement points models can be overlapped and analyzed with any other map that covers the same area.

For example, if we combine information regarding the amount of rain in a certain place with the photos, we can predict which areas will remain dry in certain times of the years. A GIS can use information coming from different sources, in different formats and can help operate analyses. By using a function known as visualization, a GIS can be used to make images not just maps, but representations, animations, sounds and so on. These images allow researchers to see the results of their work in ways never seen before. Images are frequently useful in representing technical concepts of the objects studied of a GIS [19].

### 2.3 Advantages and Risks of Using a GIS System

The advantages of using a GIS are: data is better organized, elimination of redundancy in stocking data, allows updating, analyses, statistics and searches are easier to make and users are more productive.

The risks are: complexity, high costs, land modifications and difficulty in training the personnel. Furthermore, we must say that a GIS system cannot run in a "what if" network. However, other applications developed to use the GIS data base can run in such networks.

### 2.4 The Fields of Application of GIS

GIS can be used in scientifically investigations, resource management and development planning. The applications domains of a GIS are numberless. So far we have only given examples from the ge0-topographical domain, but GIS can be used in many other domains, such as: health, Social Science, Banking, Crime, Tourism, Geology, Environment and so on.

Some of the running projects based on a GIS are:

- Using the GIS method to evaluate the cases of infant methemoglobinemia from 1985 to 1996 through which we identify the risk areas [1];

- The study representing the impact on the environment, used to help urban plans of land usage, using the OPEN GIS technology and procedures of estimating the level of pollution- using a pilot system AIRFORALL - financed by Phare, Life Medium [8];

- Biologists use radio transmitters and satellite antennas to trace the migration habits of polar bears, in

order to sustain the program dedicated to protecting animals. In GIS the migration routes have been traced using different colours for each month for a period of 21 months. The researchers have then used GIS to overlap the routes over the petrol exploration map to determine if there would be any interference.

- GIS together with information about a company's book keepings can be a possible simulation of material sedimentation in the purifying system, in the superior part of a water flow of an area predisposed to flooding [15]. Based on the quantity of water that has been used we can predict the quantity of material found in the system. It can be traced by using the GIS system [11].

- GIS allows people who plan emergency interventions to calculate the response time in natural disaster situations or they can use GIS to limit the wet areas in need of protection against pollution.

- Using maps such as wet area maps, level difference, water soil or land maps, GIS can make a new layer (situated above) that arrange moist areas in relation to the possibility of producing damage [10].

### 2.5 The Place of GIS in the Artificial Intelligence

One of the research domains of Artificial Intelligence is Knowledge representation- a fundamental domain that studies the ways in which the real world knowledge can be expressed and symbolized. As a result of this research, GIS was born. It allows working with real data, using a computer and the results are displayed in a graphic form, easy to understand and use even for a person who has not been yet initiated in this technology domain. Furthermore, we can say that GIS is an expert system (expert systems are a branch of Artificial Intelligence) that store specific data for certain domains, gathered from different sources by human experts [21].

## 3 Classification of the GIS Products, Future Research Possibilities

### 3.1 Classification of GIS Products

GIS have been not too long ago considered luxury products. Today, powerful versions for personal computers have made this application available for a wide range of users. The most important GIS products are: expert GIS products, desktop GIS products, GeoEngineering products, Web GIS products, AM/FM products and DBMS products.

- a) *Expert GIS products.* These are GIS products with a complete and complex functionality [3]. They usually require very powerful hardware and are created for specialists. They represent 1-2% of the number of users (and their number is not increasing) who spend almost 80-90% of their time creating and maintaining

geographical data. These experts are people who understand the meaning of notions such as accuracy of data, geographical projections, and topology. They are the key in the success for a GIS project.

b) *Desktop GIS products.* They are GIS products with a reduced functionality. They are aimed for PC use. They have a friendly user interface and they represent a breakthrough in the GIS domain because they bring this technology to computer users worldwide, no matter their knowledge or field of expertise. Increasing PC performance, software solutions and the development of client/server concept have considerably increased the amount of data available for PC's. Therefore, the desktop GIS product market is increasing constantly (with a rate of 24.9% more than other GIS products). Moreover, we must not forget that the price of desktop GIS projects is accessible. However, we must not ignore the limitations of this product. For example, they cannot work with big amounts of data, geographical information is hard to condense and using them requires professional training. Desktop GIS products are being used by 10 times more users than expert GIS products. The users who choose desktop GIS products are involved in decision making activities and work with geographical data 10-20% percent of their time.

c) *GeoEngineering Products.* Although they are similar to desktop GIS products, they are a result of the merger between CAD products and GIS (desktop) products. GeoEngineering products are in fact CAD products with GIS functionality. As a result, they can have fewer GIS functions than desktop GIS products.

d) *Web GIS products.* They are used for publishing maps on the Internet [2]. They usually have a Web GIS server and a client (an additional component which installs in Netscape Navigator or Internet Explorer). These products allow simple interrogations, giving fast and precise answers. The way these products work is illustrated in the Fig. 3: the client part installed in the browser makes a request to the Web GIS server and in return it gives the required information (map, text,...).

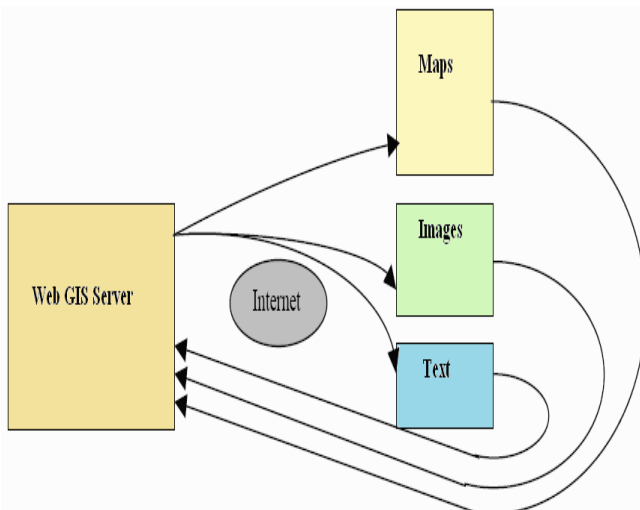


Fig. 3: Example of a GIS web server and a client.

e) *AM/FM Products (Facilities Management).* These are Expert GIS or Desktop GIS products especially designed for managing utilitarian networks [17]: water, gas, swage, phones and so on. This does not mean that utilitarian networks cannot be managed with the help of a single AM/FM product. These networks can be managed with a regular GIS. However, an AM/FM product facilitates the management of the network, because it has specialized functions.

f) *DBMSs products (DataBase management system special enabled).* These are in fact database management systems that offer the possibility of stocking space data specific for a GIS. Besides this advantage, you can also stock geographical objects and their attributes in a single database (classical one). Today there are only two products available for this category: OracleSC and SDE.

g) *Products for cartography.* Specializing in cartographic production (printing paper – Fig. 4), these products can not be considered as part of GIS.



Fig. 4: Example of printed paper.

### 3.2 Standardization Trends-OpenGIS Concept

*What is an OpenGIS and OGC?* First of all, what isn't an OpenGIS: it is not a GIS software product, it is not the name of a company or organization, and it is not a document or merchandise? OpenGIS is a project started in 1993 with the help of few federal agencies and some commercial organizations from the U.S. OpenGIS is defined as transparent access to geographical data resources and the processing of those resources in a distributed environment. From this abstract definition we can understand that OpenGIS refers to two major aspects of the GIS domain: data and applications. Because every GIS product uses specific data formats, GIS users are usually tied to a specific manufacturer for their geographical applications. Those who use products and data from several manufacturers must support a supplementary cost for data transfer and they also risk losing data integrity.

The purpose of this project is supplying a series of specifications for interfaces, which will allow application programmers to write interoperable components. Interoperability means:

- The ability of finding information and its processing instruments no matter where they are located physically.
- The ability of understanding information and its instruments no matter what platform they support and no matter where they are located.
- The ability of reaching out to more than one manufacturer.
- The ability of a manufacturer to build on infrastructures and information of another manufacturer.

The main benefits are:

- OpenGIS specifications eliminate the need of standardization of data formats and the elimination of costly data conversions.
- The open interface allows real time access of applications.

Initially, there has been talk about the future purpose of another OpenGIS (OGIS). As a result, the participants have decided that it is both useful and important to create a permanent structure dedicated to developing such specifications. Thus, in August 1994 Open GIS Consortium (OGC) has been born. OGC has the role of promoting development and use of standards, as well as promoting techniques for advanced open systems used in the area of processing space data. Nowadays, OGC administrates the OpenGIS project. OGC currently has over 100 organizations from all over the world: companies that produce GIS software, computer companies, DBMS companies, governmental agencies, universities [18].

### 3.3 Data Acquisition Equipment

*The underground radar.* If we wish to detect underground networks without digging, using underground radar must be used. The apparatus uses high frequency waves and it works on the principal of feeling out using an echo. Throughout this process, the reflections of electromagnetically impulses are analyzed. The impulses are emitted by an antenna to the object we are searching for. When the waves touch the object, reflections are created, which can be seen on the screen of the apparatus. The reflection signals are captured by an antenna. The string of reflections gives us the possibility of creating an image. This image can be seen on a monitor or a recorder. Data can be memorized on a laptop or a floppy disk for future processing. By using the underground radar, daily productivity can be estimated at almost 500-700 meters/day. Detecting underground networks is done by researching marked sections of the areas we study. On the transversal line, markings are made 0.5 meters apart. Once the minimum distance to the object is

identified, the exact spot is marked, which is registered as a land coordinate.

*Satellites.* The largest geographical data collections are images taken from satellites. These images can be scanned and then converted into vector images by using special conversion programs. The VSAT Technology (Very Small Aperture Terminal) marks an important turning point in communication satellite industry. VSAT gives a communication infrastructure based on satellite transmission, offering the possibility of data transfer, images with maximum flexibility and voice, immediate availability and a great performance/cost report. There are several satellites that cover the territory of our country, such as Eutelsat II F-4 satellite, that has been launched in July 1992 and is located at  $7^{\circ}$  E (Fig. 5). We must mention that GEOSYSTEMS Company distributes in Romania satellite images of EURIMAGE Company.



Fig. 5: Communications Satellite placed on orbit.

GPS (Global Positioning System) has three components:

- The space segment (satellites).
- Control segment (United States Department of Defence).
- The user segment (anyone who uses a GPS receptor for positioning purposes).



Fig. 6: GPS Satellite.

The space segment is made out of a constellation of 24 satellites which rotate around the Earth at an altitude of 20 000 km (Fig. 6). The satellites, which are found in one of the 6 orbital plans, surround the Earth twice a day (Fig. 7).

The GPS receptor determines its position based on radio signals received from several satellites. Satellites

have “trust-worthy” watches, thus determining the time of radio signals is very precise. The GPS receptor calculates the distances from each satellite based on the time of the radio signal and the speed of light and then uses these distances to calculate its position on Earth.

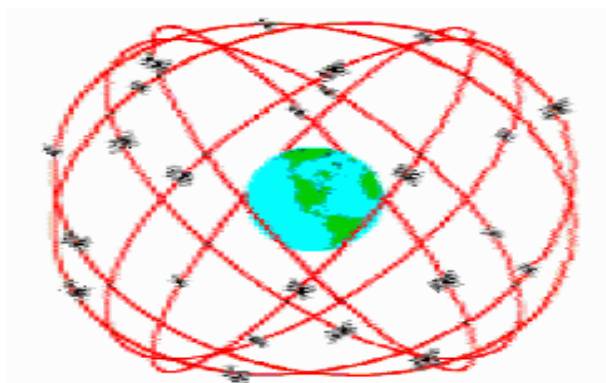


Fig. 7: Orbits plan of GPS satellites: 24 satellites in the orbital planes, 4 satellites in each Plane.

GPS satellites send out on two different frequencies (with different wave lengths: 9 cm and 24 cm). The position of these satellites can be determined using the coordinate system WGS-84. There GPS receptors with a single frequency and others with two frequencies. The last ones give an important advantage for real time applications [16].

## 4 GIS Projects Completed in Romania and Worldwide

At the beginning we briefly present some GIS projects in Europe (that are related with Romania) and then we present some projects from our country.

### 4.1 The European Motorway Databank

Even our motorways, with their holes, have been introduced in the European Motorway Databank [3].

The EMD has been made by the Faculty of Motorways from the University of Ljubljana, Slovenia in collaboration with The International Federation of Motorways from Geneva.

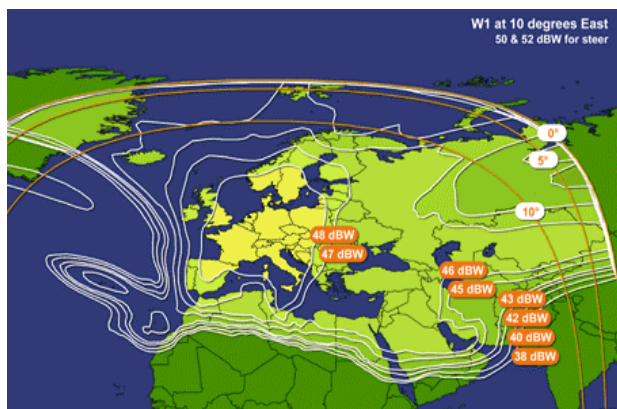


Fig. 8: Coverage of European platform SATdsl.

Data can be explored with GIS ArcView, based on the Digital Chart of the World (DCW), on a scale 1: 1.000.000 made by ESRI. In the last few years, numerous data has been introduced in EMD regarding European motorways. The data refers to the state of the motorways, traffic safety, maintenance and finance of the motorways and so on. Through the use of the powerful features of GIS ArcView and the geographical support of DCW, we can explore: thematically graphically views, space references through geographical coordinates, decisional support (Fig. 8).

### 4.2 The Control of Conventional Forces in OSCE

The geographical data of DCW have as basis other applications. This application is called VERGIS (Verification GIS) and it is used by OSCE (The Organization for Cooperation and Security in Europe) for controlling conventional forces.

### 4.3 Informatics Geographical System for Technical Track Electricity Networks - REGIS

The REGIS system resolves problems concerning technical evidence and assistance in decision making, exploring electrical distribution and transport networks, giving a solution for different hierarchical levels of the General Department of Transport and Distribution of Electrical Energy.

The main functions of the system are [20]:

- Creating/updating geographical databases as charts and situation plans, with elements specific to electrical networks (air or underground lines, their accessories, transformation points, and so on) as well as areas that these elements perambulate (buildings, roads, railroads, etc.); the degree of details depends on the scale of the map;
- Creating/updating associated table databases, having both constructive and functional characteristics of the elements in the electrical networks (no matter if they are represented on the chart or not), as well as attributes of the elements on the field;
- Viewing information from databases (as charts, drawings, and reports, so on); site selection or element selection is made either graphically or alphanumerically;
- Making specific analysis, involving both the space positioning of the objects as well as their characteristics;

The application is made with ARC/INFO (for UNIX) and with PC ARC/INFO (for the PC version) and ArcView GIS [6]. The user interface is friendly, similar to Windows or X-Windows. The product represents a useful instrument in exploring, maintaining, assisting in decision making and it is especially useful in developing/planning the structure

of the transport and distribution of electrical energy system [14].

#### 4.4 Informatics Geographical System for Monitoring the State of Historical and Archaeological Monuments

The application offers archaeologists a powerful working tool for evaluating researches and thus interpreting the results (Fig. 9). Furthermore, it can analyze and establish: the protection areas for different archaeological sites, the possibility of making them tourist friendly locations, the preservation state at a given moment.

The application has three levels [24]:

- The general plan: has a placing chart of the archaeological object on a scale of 1:25.000.
- The situation plan: have a map of the place where the object is situated and its surrounding areas, on a scale of 1:2.000.
- The overall plan: has a chart of the location with its surrounding components, on a scale of 1:50.

Every level assures:

- The selection of active layers: rivers, railroad system, main roads, curve levels, archaeological objects, power lines.
- Zoom in/ out functions.
- References about archaeological objects from the location.
- Image modifications.
- Overlapping images on location plans.
- Introducing alphanumeric information (the name of the researcher, the year of the digging, dimensions, materials, protection) about the selected element.
- Modifications: modifying a document, a layer, a state attribute.

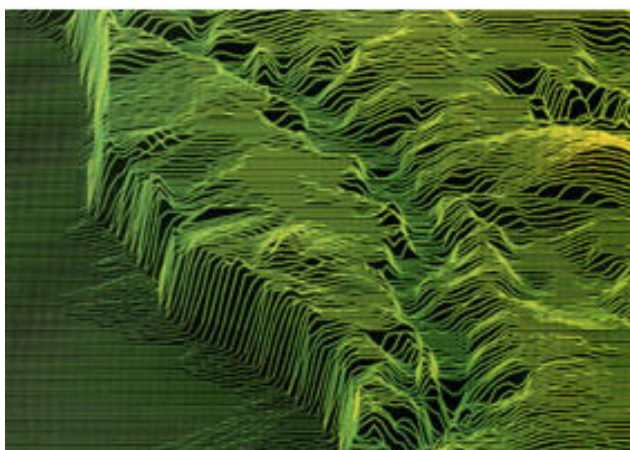


Fig. 9: Example tracking archaeological areas by GIS [25].

An important component of the application is the editor, which allows the archaeologist to build a library of layers that represents his/her version or other researcher's version on the archaeological objectives in a certain area.

Thus, it is possible [23]:

- Creating geometrical shapes;

- Editing existing layers;
- Deleting prior versions;
- Adding elements on a detail plan;
- Adding alphanumeric attributes to graphical elements;
- Sketching possible contours of archaeological objects.

For editing, the following sources can be used:

Images of the inters area;

- Topographical plans of the area;
- If we use above images, geo-reference algorithms are used and the result is overlapped on topographical maps that contain the objects.

The geo-reference procedure allows:

- Loading a picture as geographical information;
- Interactive setting of the position of the image in the geographical space of the chart;
- Selecting a rectangular part of the image to overlap on the cartographic map of the chosen area.
- If we start from a topographic plan (in real coordinates), the editor can be used for updating the plan in accordance with the latest diggings, in order to establish the protection areas of the archaeological objects.

To make this application ARC/INFO (UNIX), PC-AKC/INFO and ArcView GIS have been used.

#### 4.5 Water Network

Technical Group International has developed GIS projects using Autodesk products. In the same project they have incorporated geographical maps, construction plans and technical drawings of plumbing. The result was a complete system that can be used by both people in charge as well as workers. Thus, they manage their drawings archive using as support this project. Information is easier to find, it is organized in an open system that can be updated permanently and there are interactive work possibilities [13].

The application is organized as a tree, where we can find father – son and son- son relationships and there are three major information categories [22]:

- *Section pipe*. The first type of information is about the location of the sections. Depending on the types of charts the client has, besides location we can find information about types of relief, the position in regard to national roads, railroads and so on.

- *Pumping stations, tanks*. Information about this category is very vast. It contains construction plans, hydraulic installation plans, electrical plans, technological installations, and ventilation plans, electrical sketches of force and light, plans for each component (pumping stations, electrical stations, tanks, and buildings).

- *Steady elements*. The third big category regarding information about elements found on range (pipes, stations, tanks, etc.) is represented by a database of steady elements that the client has. After choosing a

range element, steady elements can be added or removed, can be viewed or changed, knowing all important data about the steady element (id number, norm, duration, and values).

This application requires working on two fronts:

- Scanning, transforming into vectors and making archives of existing drawings;

- Detecting the installations we are interested in.

This system is an open system, thus adding or erasing elements is very easy. It can be combined with other systems and it is designed in such a manner that it can be modified and used by any structure. The application is easily introduced in GIS products from Autodesk family, such as Autodesk Map and Autodesk Map Guide.

#### 4.6 The Informational System of Farming Land

IGFCOT has chosen Intergraph as supplier of equipment, programs and services for building The Informational System of Farming Land, which is a component of the Informational System of farming Management. The applications cover the technological process and processing of data given by analogical equipment. Data can be given in a digital format, by scanning; it can be converted from raster to vector and so on. The applications contain a subset from the MGE (Modular GIS Environment) family, a group of editing products and graphic conversion of plans, applications for archiving/ managing charts, as well as a relational management database system. The system has a client/ server architecture and it operates under Windows NT.

#### 4.7 UrbGIS

It can generate graphical or alphanumeric reports. Generating the chart of buildings is a constant function of this system (Fig. 10).

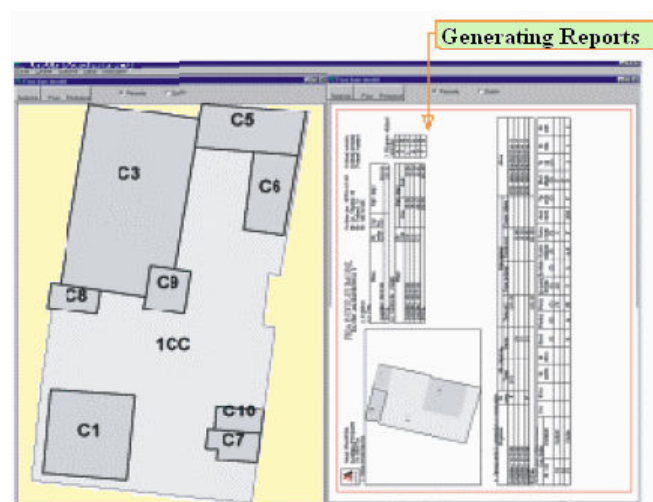


Fig. 10: An example of reports generation.

In “development” there is a great set of tools that allows us to explore the map in a tree-dimensional way, considering the height of the buildings and the digital model of the land (Fig. 11). Scanned images

(maps, satellite images) can be attached for comparison. Using vector editing functions we can modify certain entities or generate new ones, thus updating the layers of the map (Fig. 12).

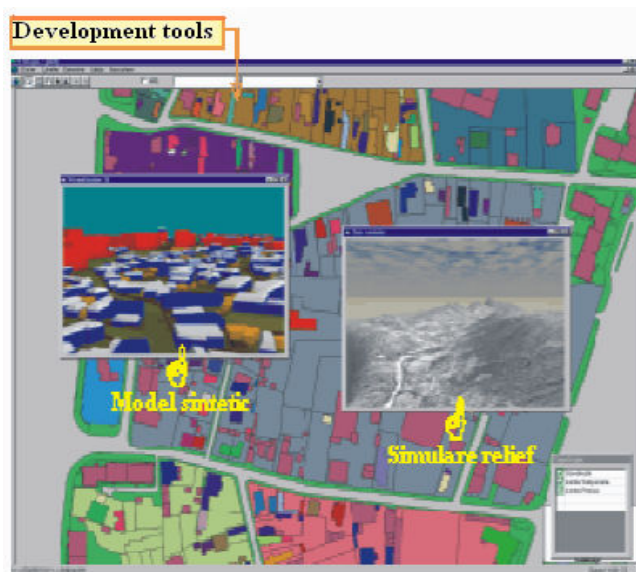


Fig. 11: An example of development tools.

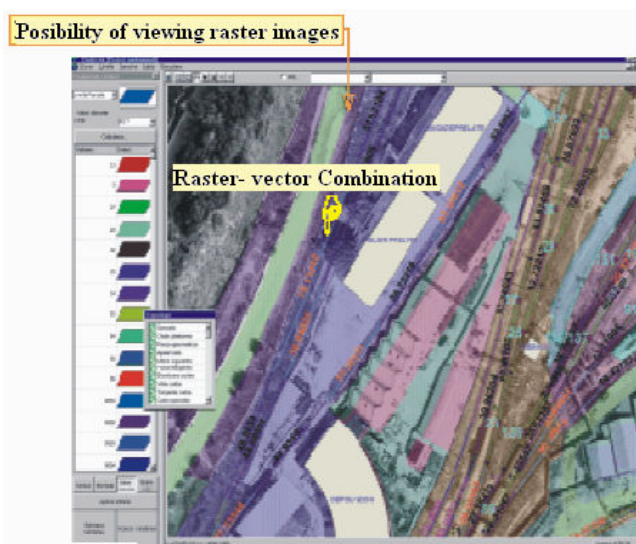


Fig. 12: Possibility of luminaries images display.

#### 4.8 Magellan System - GEOWEB Server

The Magellan System is a network application that has functions such as: editing geographical objects and displaying them.

For mobile and immobile monitoring solutions and generating maps or HTML online pages (very useful in Internet applications) Soft Agency wants to create an application called GEOWEB Server. The structure of this concept is illustrated in the Fig. 13.

As we can see there is a client/ server system made out of the following components:

- Magellan- a system whose main purpose is to edit maps and geographical objects;
- GEOWEB Server GIS - it is a GIS server whose role is to display and generate maps or html pages



based on a client request and an SQL interrogation on the client's objects;

- GEOWEB Server SQL - it is a SQL server that administrates the client's objects and has all the advantages of an SQL server: security, user accounts, access levels, stability and data integrity;
- GEOWEB Client - is a dll component that facilitates the link between a user application and the GEOWEB Server. Communication is based on a GEOWEB protocol implemented on TCP/IP and it can have an SQL interrogation to SQL server.

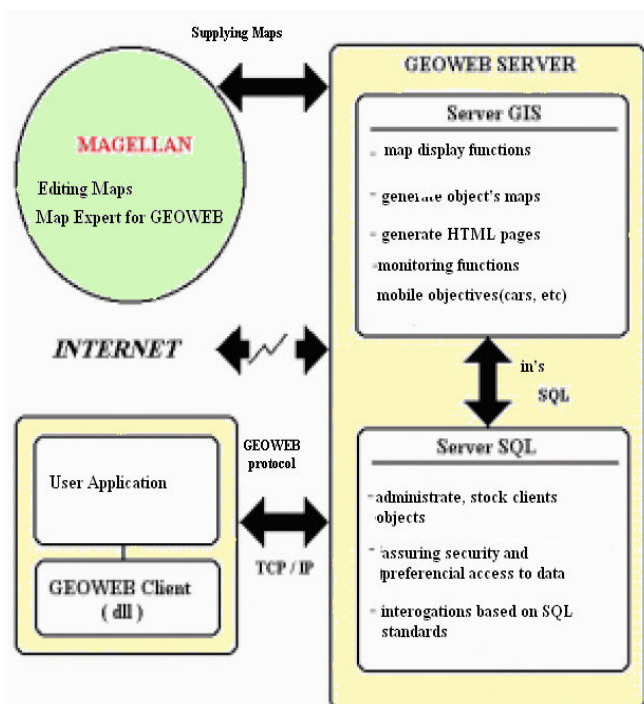


Fig. 13: Architecture of system Magellan – GeoWeb Server.

#### GEOWEB SERVER GIS - Functionalities.

GEOWEB Server GIS- it is a GIS server whose role is to display and generate maps or html pages based on a client request and an SQL interrogation on the client's objects. It receives commands from a client (a client can be a different user application) based on GEOWEB protocol. This protocol can be extended at the client's request. The main commands are:

- Generate the map where objects a, b, c... are;
- Generate the map where object X is;
- Generate the city's map where object X is located;
- Generate the map around GPS coordinates, lat., and long;
- Generate the map with the course of the mobile object X between the hours...;
- Generate an html page for any of the above situations;
- Generate an html page with objectives that satisfy a certain SQL interrogation processed by the SQL server.

This server can also display the requests, making it a very good server for monitoring mobile objects with

GPS-GSM (Fig. 14). It can have the following functionalities:

- Display all mobile objectives from a certain city;
- Display the course and position of a certain mobile object, with the possibility of jumping from a map to another;
- Tell when a certain object has exited a given perimeter;
- Tell when a certain object is stationed more than it should or it is driven out of course;
- Other functionalities at the client's request.

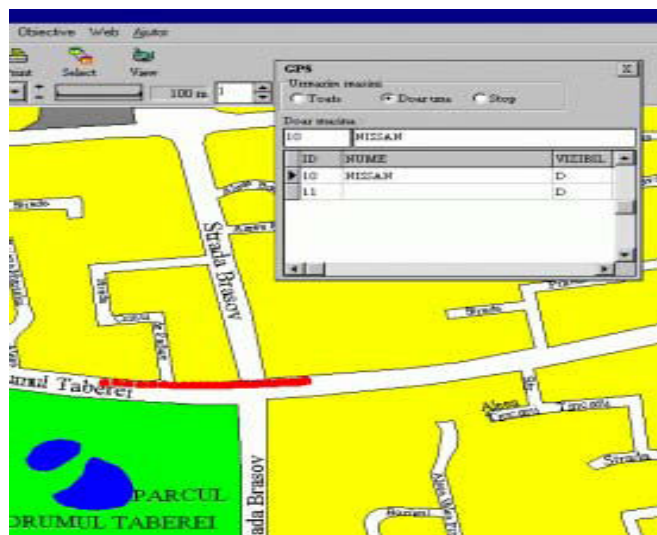


Fig. 14: Example of monitoring of mobile objectives with systems GPS - GSM.

## 5 Conclusions

A GIS system is designed to model information, processes and structures that mirror the world as it exists, including its history, in order to understand, analyze and manage resources and facilities.

A GIS and can be described like a corporate database management system which generally presents the data interactively to users in a seamless, graphical view that can easily be queried and analyzed.

Generally, the data from a GIS system, may be divided into background and foreground data corresponding to a map base respectively objects in real world that need to be represented in the system.

To start working in a GIS system you must have an adequate database (some form of map base completely covering the area of the GIS) which is obtained after a data capture process.

Largest costs for any organization embarking on the implementation of a GIS are data conversion, hardware and software and system implementation particularity customization but these costs are covered in time by the efficiency of work and the ability to take decisions in real time.

One of the aims of this paper is to provide a comprehensive set of specifications for interfaces that will enable application developers to write interoperable components.

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